



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : D21F 3/02	A1	(11) International Publication Number: WO 91/00389 (43) International Publication Date: 10 January 1991 (10.01.91)
(21) International Application Number: PCT/US90/02147 (22) International Filing Date: 19 April 1990 (19.04.90) (30) Priority data: 370,933 23 June 1989 (23.06.89) US (71) Applicant: BELOIT CORPORATION [US/US]; One St. Lawrence Avenue, Beloit, WI 53511 (US). (72) Inventors: CROUSE, Jere, W. ; 3521 Circle Wood Drive, Beloit, WI 53511 (US). PULKOWSKI, Jeffrey, H. ; 1330 Ninth Street, Beloit, WI 53511 (US). PORTER, Roy, J. ; R.R. 5, Suburban Drive, Beloit, WI 53511 (US).		(74) Agent: ARCHER, David, J.; One St. Lawrence Avenue, Beloit, WI 53511 (US). (81) Designated States: AT (European patent), AU, BE (European patent), BR, CA, CH (European patent), DE (European patent)*, DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent). Published <i>With international search report.</i>
(54) Title: A HEATED EXTENDED NIP PRESS APPARATUS <div data-bbox="428 1113 1240 1692" data-label="Image"> </div>		
(57) Abstract <p>A heated extended nip press apparatus (10) is disclosed for pressing water from a formed web (W). The apparatus (10) includes a frame (12) and a backing roll (14) rotatably supported by the press frame (12). A press device (16) is connected to the press frame (12) and movable relative to the backing roll (14). The press device (16) cooperates with the backing roll (14) for defining therebetween an extended nip (N) for the passage therethrough of the web (W). An endless looped blanket (18) extends through the extended nip (N) such that the web (W) is disposed between the blanket (18) and the backing roll (14). Additionally, the press device (16) includes an arrangement for selectively changing the pressure applied on the blanket (18) along a machine direction (MD) relative to a further pressure (P) applied for moving the press device (16) relative to the backing roll (14) such that optimum web properties are obtained and delamination of the pressed web (W) is inhibited.</p>		

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MC	Monaco
AU	Australia	FI	Finland	MG	Madagascar
BB	Barbados	FR	France	ML	Mali
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GR	Greece	NL	Netherlands
BJ	Benin	HU	Hungary	NO	Norway
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	SD	Sudan
CF	Central African Republic	KP	Democratic People's Republic of Korea	SE	Sweden
CG	Congo	KR	Republic of Korea	SN	Senegal
CH	Switzerland	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
DE	Germany, Federal Republic of	LU	Luxembourg	TG	Togo
DK	Denmark			US	United States of America

TITLE: A HEATED EXTENDED NIP PRESS APPARATUS

BACKGROUND OF THE INVENTION:

FIELD OF THE INVENTION:

The present invention relates to a heated extended nip press apparatus and a method for obtaining optimum web properties while inhibiting delamination of the pressed web.

INFORMATION DISCLOSURE STATEMENT:

Extended nip press arrangements have enabled the removal of far greater quantities of water from the formed web when compared with more conventional roll presses which include at least a pair of cooperating rolls defining therebetween a press nip.

More particularly, such extended nip presses have reduced the costs involved in the subsequent drying of the pressed web in a dryer section.

An extended nip press essentially includes a backing roll and a press shoe having a concave surface which cooperates with the backing roll for defining therebetween an extended nip. An endless looped blanket moves contiguously with a felt and the formed web through the extended nip with the interface between the blanket and the shoe being lubricated. The felt acts as a carrier for the weak wet web and collects water therefrom. Accordingly, by the application of pressure for an increased period of time, the increased residence time not only enables the removal of more water from the formed web but also in certain applications improves the properties of the resultant web.

More recently, as disclosed in U.S. Patent No. 4,738,752 to Busker et al, the extended nip press arrangement has been enhanced by the application of heat to

the backing roll, such heat being applied to the backing roll typically by means of an induction heater.

Evidently, the application of induction heating reduces the viscosity of the water within the formed web thereby facilitating the removal of more water from the web. Additionally, the application of thermal energy causes the generation of steam within the extended nip, such that the steam within the web forces water in the liquid phase out of the web thereby further enhancing the water removing capabilities of the extended nip press.

However, in view of the rapid generation of steam within the extended nip, there existed a certain tendency of the web to delaminate on exiting from the extended nip. Accordingly, various temperatures were used with different residence times and pressures in an attempt to minimize such tendency to delaminate.

During the course of such experimentation, a discovery was made that by gradually decreasing the pressure in a machine direction towards the trailing edge of the shoe, rapid flashing of steam from the emerging pressed web was avoided. Rapid flashing of steam from the web was recognized as being the main cause of the delamination problem.

By selectively changing the pressure applied on the blanket along a machine direction, not only was the problem of delamination alleviated but unexpectedly the properties of the resultant pressed web were enhanced.

Therefore, it is a primary object of the present invention to provide a heated extended nip press apparatus which overcomes the aforementioned problems associated with the prior proposals and which makes a considerable contribution to the art of high temperature pressing.

Another object of the present invention is the provision of a press means which includes means for selectively changing the pressure applied on a blanket along a machine direction relative to a further pressure applied for moving the press means relative to the backing roll such that optimum web properties are obtained and delamination of the pressed web is inhibited.

Another object of the present invention is the provision of a heated extended nip press apparatus having an induction heater disposed closely adjacent to the backing roll for heating the backing roll thereby increasing the amount of water removed from the formed web during passage of the web through the extended nip.

Another object of the present invention is the provision of a heated extended nip press apparatus which includes a hydrodynamic shoe defining therein a plurality of cross-machine directional recesses. The recesses selectively cooperate with a piston so that the shoe is permitted to pivot about the piston, the shoe being selectively positioned in a machine direction relative to the piston to optimize the web properties and to inhibit delamination of the pressed web.

Another object of the present invention is the provision of a heated extended nip press apparatus in which the press means includes a rod rigidly secured to a piston and disposed between the piston and the shoe. The rod extends in a cross-machine direction such that the rod pivotally supports and is selectively disposed within one of the plurality of recesses.

Another object of the present invention is the provision of a heated extended nip press apparatus which includes a hydrostatic shoe defining a plurality of pockets disposed in a machine direction with each of the pockets being selectively connected to a source of hydraulic pressure such that the blanket is hydrostatically supported

by the shoe and so that optimum web properties are obtained and delamination of the pressed web is inhibited.

Other objects and advantages of the present invention will be readily apparent to those skilled in the art by a consideration of the detailed description contained hereinafter taken in conjunction with the annexed drawings.

SUMMARY OF THE INVENTION:

The present invention relates to a heated extended nip press apparatus and method for pressing water from a formed web. The apparatus includes a press frame and a backing roll rotatably supported by the press frame. A press means is connected to the press frame and movable relative to the backing roll. The press means cooperates with the backing roll for defining therebetween an extended nip for the passage therethrough of the web. An endless looped blanket extends through the extended nip such that the web is disposed between the blanket and the backing roll. The press means also includes means for selectively changing the pressure applied on the blanket along a machine direction relative to a further pressure applied for moving the press means relative to the backing roll such that optimum web properties are obtained and delamination of the pressed web is inhibited.

In a more specific embodiment of the present invention, the extended nip press apparatus includes an induction heater which is disposed closely adjacent to the backing roll for heating the backing roll thereby increasing the amount of water removed from the formed web during passage of the web through the extended nip.

Additionally, the present invention includes a heated extended nip press apparatus in which the press means also includes a press member defining a bore, the bore being connected to a source of hydraulic pressure. A piston sealingly and slidably cooperates with the bore such that when the bore is selectively connected to the source of

hydraulic pressure, the piston moves relative to the backing roll. A shoe is connected to the piston so that the shoe slidably cooperates with the blanket.

In one embodiment of the present invention, the shoe is a hydrodynamic shoe which is pivotally connected to the piston.

More specifically, the hydrodynamic shoe defines a plurality of cross-machine directional recesses. The recesses selectively cooperate with the piston so that the shoe is permitted to pivot about the piston. The shoe is selectively positioned in a machine direction relative to the piston to optimize the web properties and to inhibit delamination of the pressed web.

More specifically, the press means also includes a rod which is rigidly secured to the piston and disposed between the piston and the shoe. The rod extends in a cross-machine direction such that the rod pivotally supports and is selectively disposed within one of the plurality of recesses.

In another embodiment of the present invention, the shoe is rigidly secured to the piston. The shoe defines a plurality of pockets disposed in a machine direction with each of the pockets being selectively connected to a source of hydraulic pressure such that the blanket is hydrostatically supported by the shoe and so that optimum web properties are obtained and delamination of the pressed web is inhibited.

In a further embodiment of the present invention, the hydrostatic shoe is pivotally secured relative to the piston about a cross-machine directional pivotal axis. The hydrostatic shoe defines a plurality of pockets which are spaced relative to each other in a machine direction. Each of the pockets are selectively connected to the source of hydraulic pressure for selectively applying different

hydrostatic pressures on the blanket in a machine direction so that optimum web properties are obtained and delamination of the pressed web is inhibited.

In a heated extended nip press apparatus, a method for pressing water from a formed web, the method comprising the steps of moving the web contiguously with an endless looped blanket through an extended nip defined between a backing roll and a press means movable relative to the backing roll such that the web is disposed between the blanket and the backing roll; and selectively changing the pressures applied on the blanket along a machine direction relative to a further pressure applied for moving the press device relative to the backing roll such that optimum web properties are obtained and delamination of the pressed web is inhibited.

Many modifications and variations of the present invention will be readily apparent to those skilled in the art from a consideration of the detailed description contained hereinafter. However, such modifications and variations fall within the spirit and scope of the present invention as defined by the appended claims.

Included in such modifications would be the use of any type of heating means for heating the backing roll including gas fired heating, radiant heating, or the like.

Furthermore, variations of the present invention could include the provision of a porous surfaced backing roll such as disclosed in co-pending patent application Serial No. 07/089,887 to Pulkowski et al and U.S. Patent No. 4,738,752. All of the disclosure of U.S. Patent No. 4,738,752 and pending application 07/089,887 are incorporated herein by reference.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 is a fragmentary elevational view of a heated extended nip press apparatus according to the present invention;

Figure 2 is an enlarged side-elevational view of a hydrodynamic shoe according to the present invention together with a graph showing the pressure curves when the shoe is pivoted about the second, third and fourth recesses respectively;

Figure 3 is a side-elevational view similar to the arrangement shown in Figure 1 but with a shoe having seven recesses and with the rod disposed in the first recess and showing the corresponding resultant pressure curve;

Figure 4 is a similar view to that shown in Figure 3 but shows the rod disposed in the seventh recess and the corresponding resultant pressure curve;

Figure 5 is a similar view to that shown in Figure 3 but shows the rod disposed in the fourth recess and the corresponding pressure curve;

Figure 6 is a graph showing the various pressure curves or pressure profiles resulting from pivoting the hydrodynamic shoe shown in Figure 1 about the first to the fifth recess respectively;

Figure 7 is a graph showing the results of a test carried out using a hydrodynamic shoe shown in Figures 3-5 defining therein seven recesses, such graphs showing the pressure profiles obtained by pivoting the shoe about the first and seventh recess respectively;

Figure 8 is a graph showing the pressure profile for a hydrodynamic shoe pivoted about the fourth recess;

Figure 9 is a graph showing various pressure profiles which indicate the results of tests to alleviate delamination and to enhance paper properties;

Figure 10 is a fragmentary side-elevational view of a further embodiment of the present invention in which the shoe is a hydrostatic shoe defining a plurality of pockets therein disposed in a machine direction;

Figure 11 is a side-elevational view of a further embodiment of the present invention in which a hydrostatic shoe is pivotally secured relative to a piston and shows the pressure profile obtained thereby; and

Figure 12 is an enlarged view of the arrangement shown in Figure 10 but shows an increased pressure being applied towards the trailing edge of the shoe.

Similar reference characters refer to similar parts throughout the various embodiments of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS:

Figure 1 is a fragmentary side-elevational view of a heated extended nip press apparatus generally designated 10 for pressing water from a formed web W. The apparatus 10 includes a press frame 12 and a backing roll 14 rotatably supported by the press frame 12. A press means generally designated 16 is connected to the press frame 12 and movable relative to the backing roll 14. The press means 16 cooperates with the backing roll 14 for defining therebetween an extended nip N for the passage therethrough of the web W. The web W is carried into the nip N and through the nip N on felt F. An endless looped blanket 18 extends through the extended nip N such that the web W on the felt F is disposed between the blanket 18 and the backing roll 14. The web is pressed against the heated backing roll 14 and the felt F is pressed against the blanket 18. The press means 16 also includes means generally designated 20 for selectively changing the

pressure applied on the blanket 18 along a machine direction as indicated by the arrow MD relative to a further pressure as indicated by the arrow P applied for moving the press means 16 relative to the backing roll 14 such that optimum web properties are obtained and delamination of the pressed web W is inhibited.

Figure 1 also shows an induction heater 22 disposed closely adjacent to the backing roll 14 for heating the backing roll 14 thereby increasing the amount of water removed from the formed web W during passage of the web W through the extended nip N.

As shown in Figure 1, the press means 16 also includes a press member 24 defining a bore 26. The bore 26 is connected to a source of hydraulic pressure 28. A piston 30 sealingly and slidably cooperates with the bore 26 such that when the bore 26 is selectively connected to the source of hydraulic pressure 28, the piston 30 moves relative to the backing roll 14.

As shown in Figure 1, the heated extended nip press apparatus 10 includes a shoe 32 which is a hydrodynamic shoe pivotally connected at 34 to the piston 30.

As shown in Figure 2, the shoe 32 defines a plurality of cross-machine directional recesses 36, 37, 38, 39 and 40. The recesses 36 to 40 selectively cooperate with the piston 30 so that the shoe 32 is permitted to pivot about the piston 30. The shoe 32 is selectively positioned in the machine direction MD relative to the piston 30 to optimize the web properties and to inhibit delamination of the pressed web W.

More specifically, as shown in Figure 1, the press means 16 further includes a rod 42 rigidly secured to the piston 30 and disposed between the piston 30 and the shoe 32. The rod 42 extends in a cross-machine direction such that the rod 42 pivotally supports and is selectively

disposed within one of the plurality of recesses 36 to 40. Figure 1 shows the rod 42 disposed within the second recess 37.

Figure 2 is an enlarged side-elevational view of the shoe 32 shown in Figure 1 and shows the first, second, third, fourth and fifth recesses 36 to 40 respectively. The shoe 32 defines a concave surface 44 which cooperates with the backing roll 14 for defining therebetween the extended nip N. The shoe 32 also includes a leading and a trailing end 46 and 48 respectively. Figure 2 shows the pressure curves, or pressure profiles, 50, 51 and 52 respectively when the rod 42 is disposed within the second, third and fourth recess 37, 38 and 39 respectively.

Accordingly, the position of the shoe 32 can be moved relative to the rod 42 in a machine direction MD so as to alter the pressure profile within the extended nip N. Generally, it has been found preferable to gradually decrease the pressure as shown in pressure profiles 52 with the rod 42 disposed within the fourth recess 39 so that the tendency for rapid flashing of steam is minimized thereby inhibiting delamination of the resultant web W.

Figure 3 is a side-elevational view of a similar arrangement to that shown in Figures 1-2 but showing a shoe having seven recesses. The rod 42 is disposed within the first recess 36' resulting in a pressure profile 49 in which the pressure rapidly decreases towards the trailing edge 48' of the shoe 32'.

Figure 4 is a similar view to that shown in Figure 3 but shows the rod 42' disposed within the seventh recess 40' thereby resulting in a pressure profile 53' in which the pressure gradually decreases from a maximum value at the peak 56' of the profile 53' to a substantially zero pressure at the trailing edge 48' of the shoe 32'.

Figure 5 is a similar view to that shown in Figure 3 but shows the rod 42' disposed within the fourth recess 39' resulting in a pressure profile 52' in which the pressure fairly gradually decreases from a maximum at the peak 58' to the exit point 60' adjacent to the trailing edge 48' of the shoe 32'.

Figure 6 is a graph showing the pressure profiles 49, 50, 51, 52 and 53 resulting from the positioning of the rod 42 within the recesses 36 to 40 respectively.

Figure 7 is another graph but showing the results obtained using the shoe defining seven recesses and shown in Figures 3-5 and shows the pressure profiles 49' and 53' resulting from the disposition of the rod 42' within the first and seventh recess respectively.

Figure 8 is a graph showing the pressure profile resulting from the use of another shoe having a plurality of recesses defined therein, the pressure profile resulting from the rod 42 being positioned within a fourth recess.

Figure 9 is a graph showing the various pressure profiles tested in an effort to alleviate delamination and enhance paper properties. Certain profiles are achievable with hydrodynamic shoes, others with hydrostatic shoes. Pressure profile 50 is achieved with a hydrodynamic shoe, 32 with the rod 42 disposed within recess 37. The choice of the pressure profile is dependent on web sensitivity to delamination and upon the properties desired.

Figure 10 is a fragmentary side-elevation view of an alternative embodiment of the present invention in which a shoe 32A is a hydrostatic shoe defining a plurality of pockets generally designated 62. More specifically, a first pocket 64 is disposed adjacent to the leading edge 46A of the shoe 32A and a second pocket 66 is disposed adjacent to the trailing edge 48A of the shoe 32A. The hydraulic pressure applied to the pockets 64 and 66 via hydraulic

lines 68 and 70 respectively are selectively controlled in order to obtain an optimum pressure profile 58A as shown in Figure 10.

Figure 11 is a side-elevational view of a further embodiment of the present invention in which a hydrostatic shoe 32B is pivotally secured at 34B to a piston 30B.

Figure 12 is an enlarged view of the embodiment shown in Figure 10 showing the pressure profile 58A which may be changed by varying the pressure differential within the first and second pockets 64 and 66 respectively.

In operation of the apparatus shown in Figures 1 to 9 using a hydrodynamic shoe, the hydraulic pressure within the bore 26 is disconnected so that the piston 30 and the shoe 32 supported thereon is lowered away from the backing roll 14. The shoe is then moved in the machine direction MD so that the rod 42 engages a different recess so that the optimum pressure profile for a particular furnish can be obtained.

In operation of the apparatus shown in Figures 10 to 12, the difference in pressure within the pockets 64 and 66 can be controlled and varied in order to optimize web properties and to inhibit delamination without lowering the shoe relative to the backing roll.

In the practice of the present invention, it is very important that the entrance and exit tail of the pressure profile shape be smooth in order to avoid delamination. Furthermore, it is important to note that the hydrostatic pressure pockets may be individually controlled in both a machine direction and a cross-machine direction locations.

During high temperature pressing, the exiting dryness, density and strength properties of the sheet being pressed were found to be influenced by the temperature, time in the nip, and pressure. These properties can be tailored by

various combinations of pressure profile shape. In most cases, the sheet properties can be improved by proper combinations of all the aforementioned variables. Temperature and nip residence time have been found to be the most influential in building sheet properties. Furthermore, tests have indicated that the pressure profile shape can also be used to build sheet properties. Exiting dryness in particular can be improved. Strength and bulk also appear to be influenced. For example, the pressure profile shape 54 may produce a higher strength sheet with the same bulk as that with profile shape 52 shown in Figure 6. The position number 7 shown as profile 53' in Figure 7 may densify the sheet more than profile number 52 shown in Figure 6 or 52A of Figure 8 with subsequent improvement in strength.

The present invention provides a relatively inexpensive means for altering the machine direction pressure profile within a heated extended nip press thereby optimizing web properties and avoiding any tendency of the web to delaminate.

What is claimed is:

1. A heated extended nip press apparatus (10) for pressing water from a formed web (W), said apparatus comprising:
 - a press frame (12);
 - a backing roll (14) rotatably supported by said press frame (12);
 - a press means (16) connected to said press frame (12) and movable relative to said backing roll (14), said press means (16) cooperating with said backing roll (14) for defining therebetween an extended nip (N) for the passage therethrough of the web (W);
 - an endless looped blanket (18) extending through said extended nip (N) such that the web (W) is disposed between said blanket (18) and said backing roll (14); and
 - said press means (16) including:
 - means (20) for selectively changing the pressures applied on said blanket (18) along a machine direction (MD) relative to a further pressure (P) applied for moving said press means (16) relative to said backing roll (14) such that optimum web properties are obtained and delamination of the pressed web (W) is inhibited.
2. A heated extended nip press apparatus (10) as set forth in claim 1 further including:
 - an induction heater (22) disposed closely adjacent to said backing roll (14) for heating said backing roll (14) thereby increasing the amount of water removed from the formed web (W) during passage of the web (W) through said extended nip (N).
3. A heated extended nip press apparatus (10) as set forth in claim 1 wherein said press means (16) further includes:

a press member (24) defining a bore (26), said bore (26) being connected to a source of hydraulic pressure (28);
a piston (30) sealingly and slidably cooperating with said bore (26) such that when said bore (26) is selectively connected to said source of hydraulic pressure (28), said piston (30) moves relative to said backing roll (14);
a shoe (32) connected to said piston (30) such that said shoe (32) slidably cooperates with said blanket (18).

4. A heated extended nip press apparatus (10) as set forth in claim 3 wherein said shoe (32) is a hydrodynamic shoe which is pivotally connected to said piston (30).

5. A heated extended nip press apparatus (10) as set forth in claim 4 wherein said shoe (32) defines a plurality of cross-machine direction recesses (36,37,38,39,40), said recesses (36 to 40) selectively cooperating with said piston (30) so that said shoe (32) is permitted to pivot about said piston (30), said shoe (32) being selectively positioned in a machine direction (MD) relative to said piston (30) to optimize said web properties and to inhibit delamination of the pressed web (W).

6. A heated extended nip press apparatus (10) as set forth in claim 5 wherein said press means (16) further includes:

a rod (42) rigidly secured to said piston (30) and disposed between said piston (30) and said shoe (32), said rod (42) extending in a cross-machine direction such that said rod (42) pivotally supports and is selectively disposed within one of said plurality of recesses (36 to 40).

7. A heated extended nip press apparatus (10) as set forth in claim 3 wherein said shoe is rigidly secured to said piston, said shoe defining a plurality of pockets disposed in a machine direction, each of said pockets being

selectively connected to said source of hydraulic pressure such that said blanket is hydrostatically supported by said shoe and so that said optimum web properties are obtained and delamination of the pressed web is inhibited.

8. A heated extended nip press apparatus (10) as set forth in claim 3 wherein said shoe is pivotally secured relative to said piston about a cross-machine directional pivotal axis, said shoe defining a plurality of pockets spaced relative to each other in a machine direction, each of said pockets being selectively connected to said source of hydraulic pressure for selectively applying different hydrostatic pressures on said blanket in a machine direction such that said optimum web properties are obtained and delamination of the pressed web is inhibited.

9. In a heated extended nip press apparatus (10), a method for pressing water from a formed web (W), the method comprising the steps of:

moving the web (W) contiguously with an endless looped blanket (18) through an extended nip (N) defined between a backing roll (14) and a press means (16) movable relative to the backing roll (14) such that the web (W) is disposed between the blanket (18) and the backing roll (14); and

selectively changing the pressures applied on the blanket (18) along a machine direction (MD) relative to a further pressure applied for moving the press device relative to the backing roll (14) such that optimum web properties are obtained and delamination of the pressed web (W) is inhibited.

1 / 6

FIG. 1

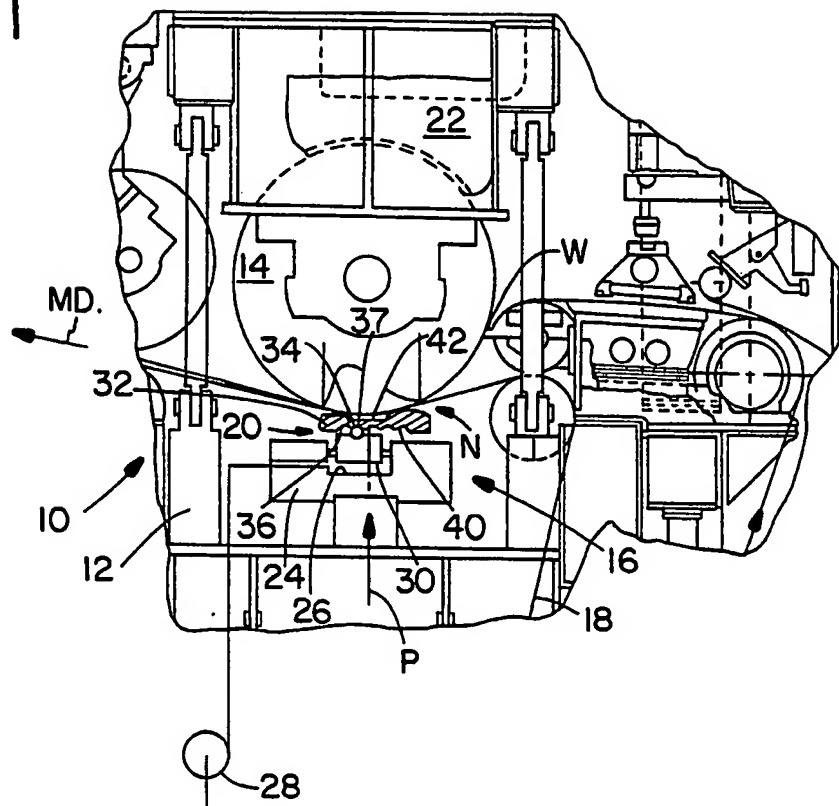
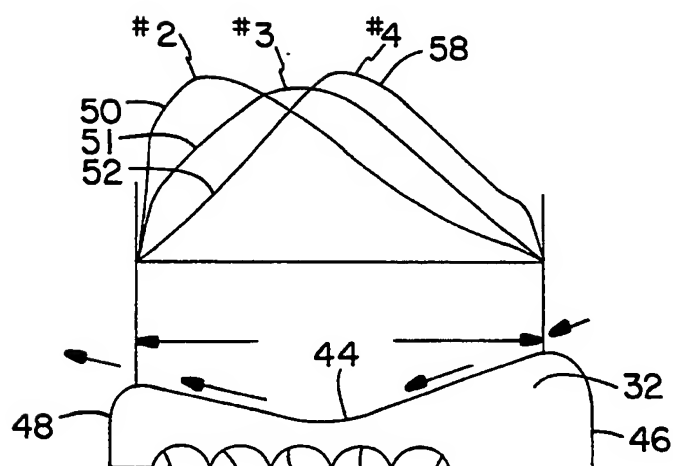


FIG. 2



#2 .04696 VS. 27.23 psi-sec
 #3 .05095 VS. 29.55 psi-sec
 #4 .04992 VS. 28.95 psi-sec

SUBSTITUTE SHEET

3 / 6

FIG. 5

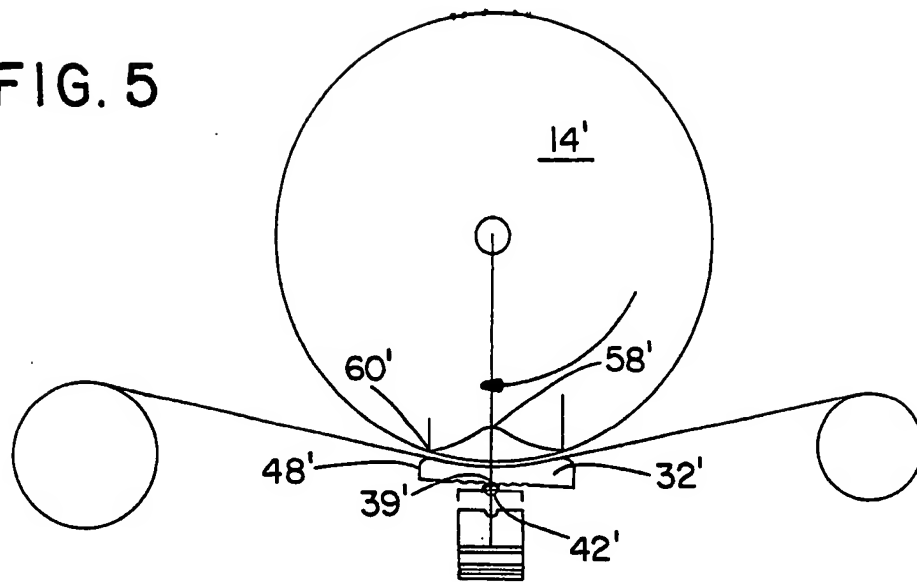
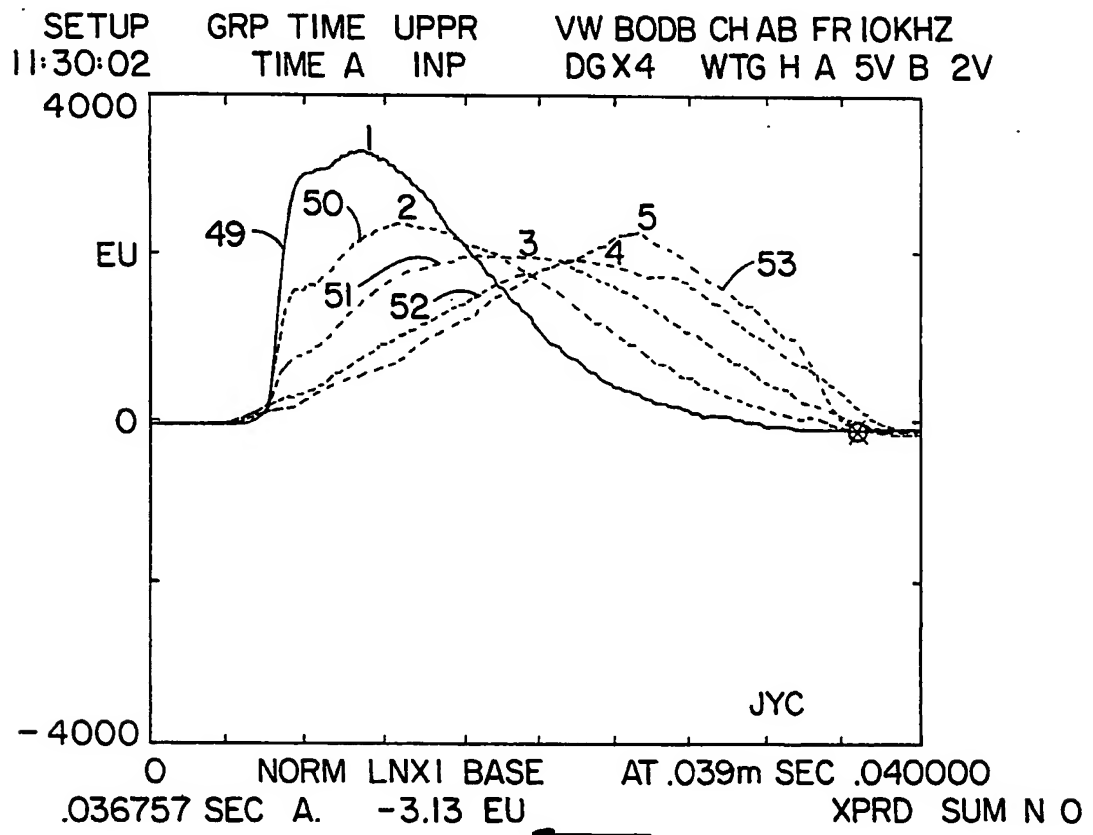
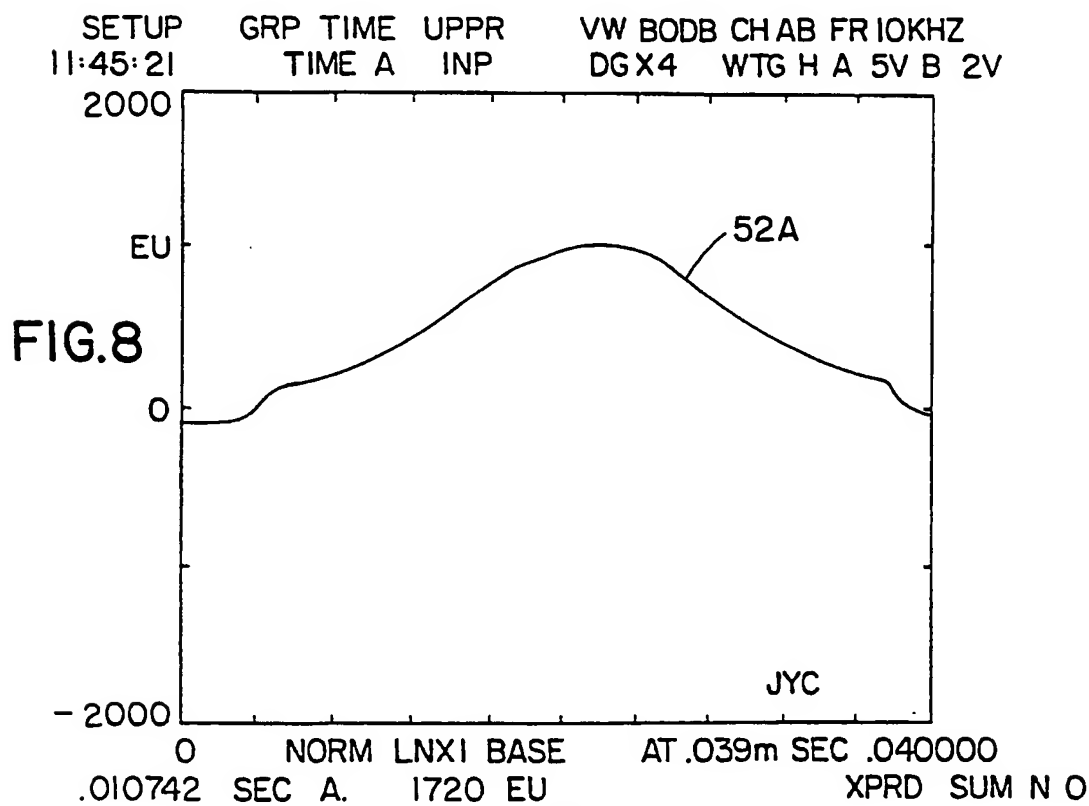
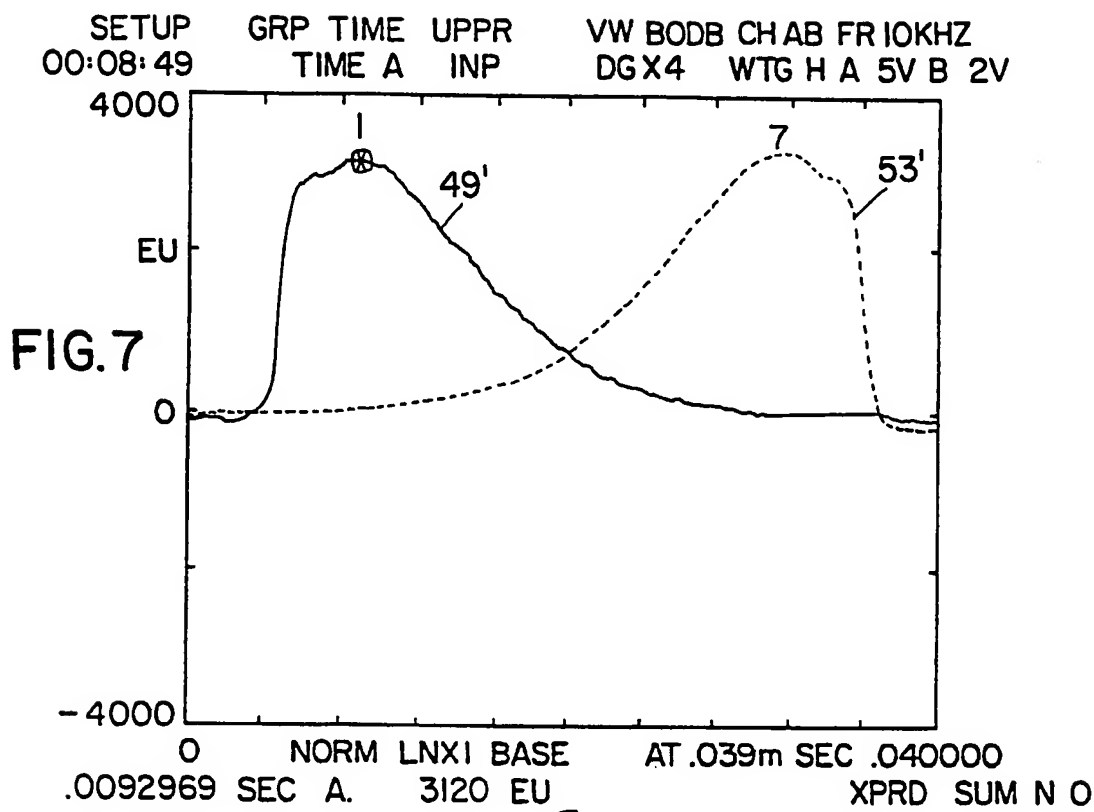


FIG. 6



4 / 6



SUBSTITUTE SHEET

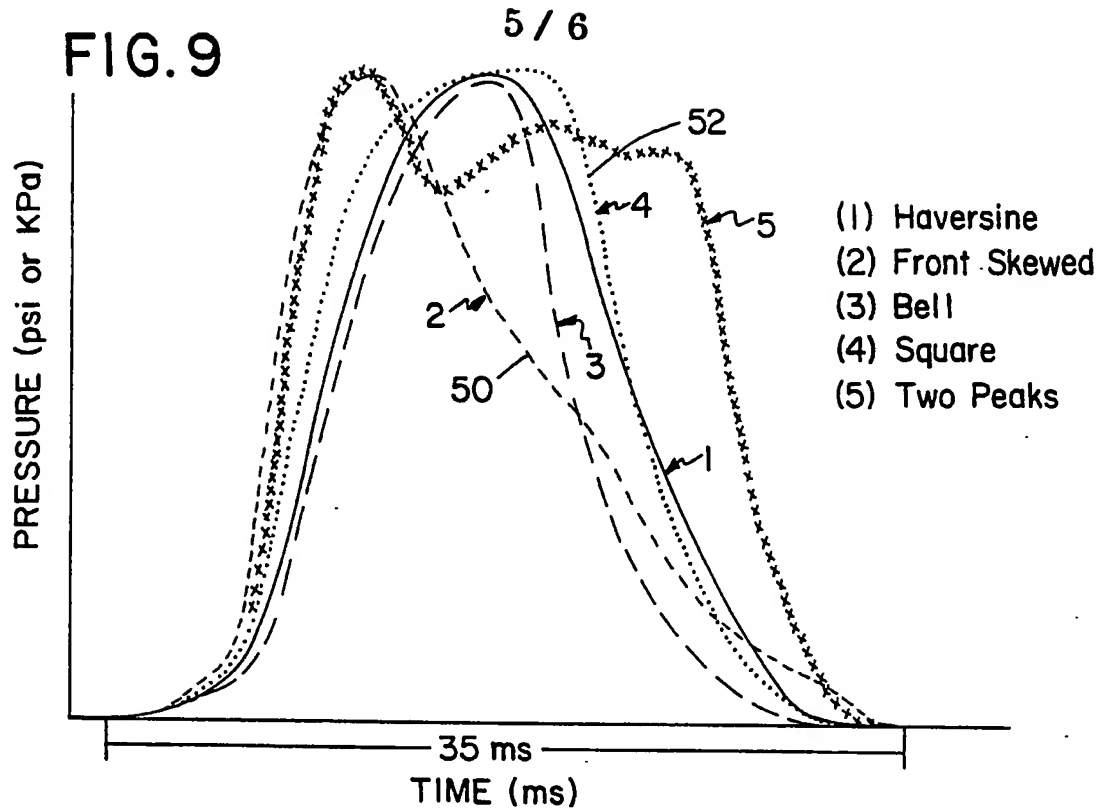
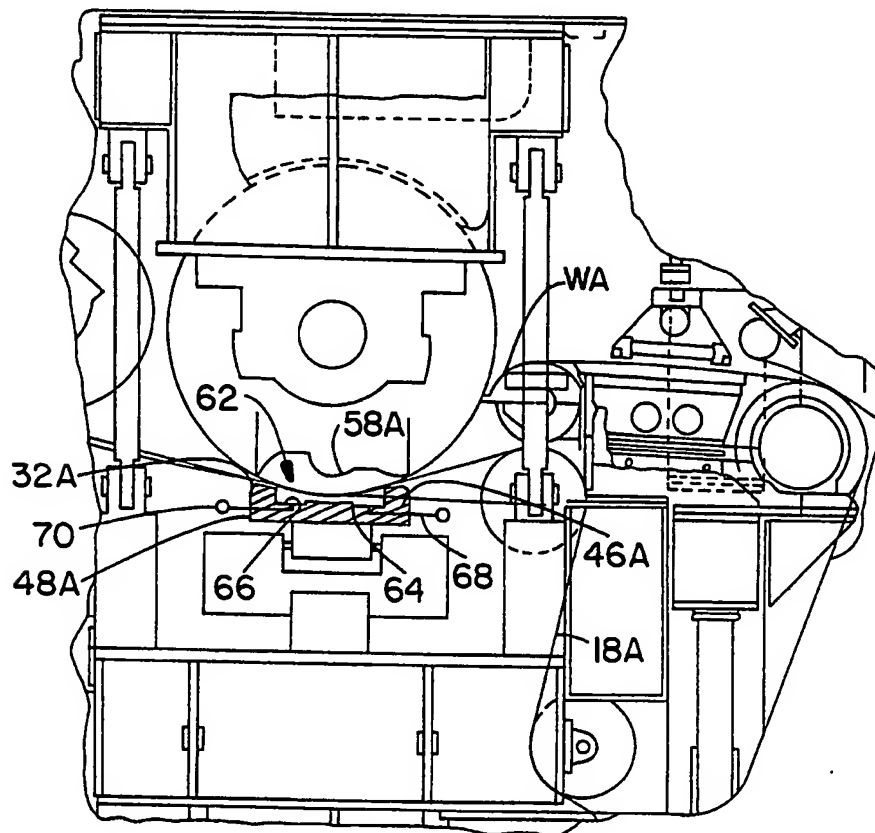


FIG. 10



SUBSTITUTE SHEET

6 / 6

FIG. 11

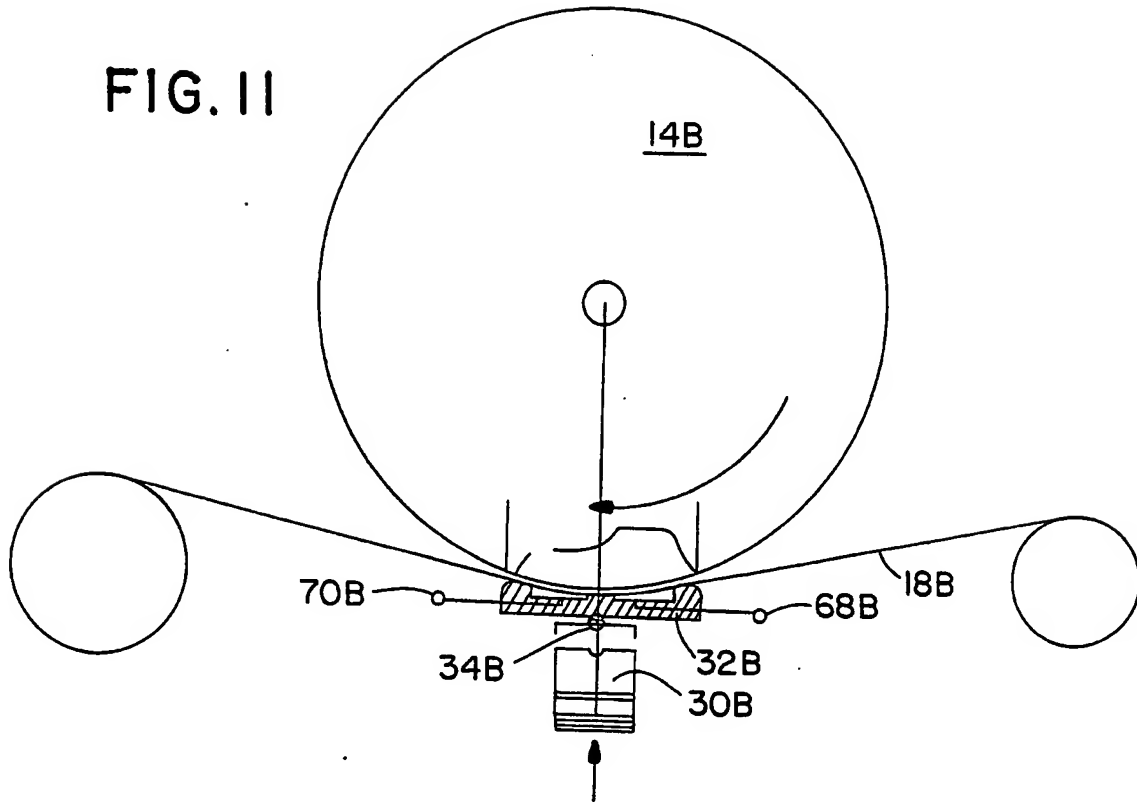
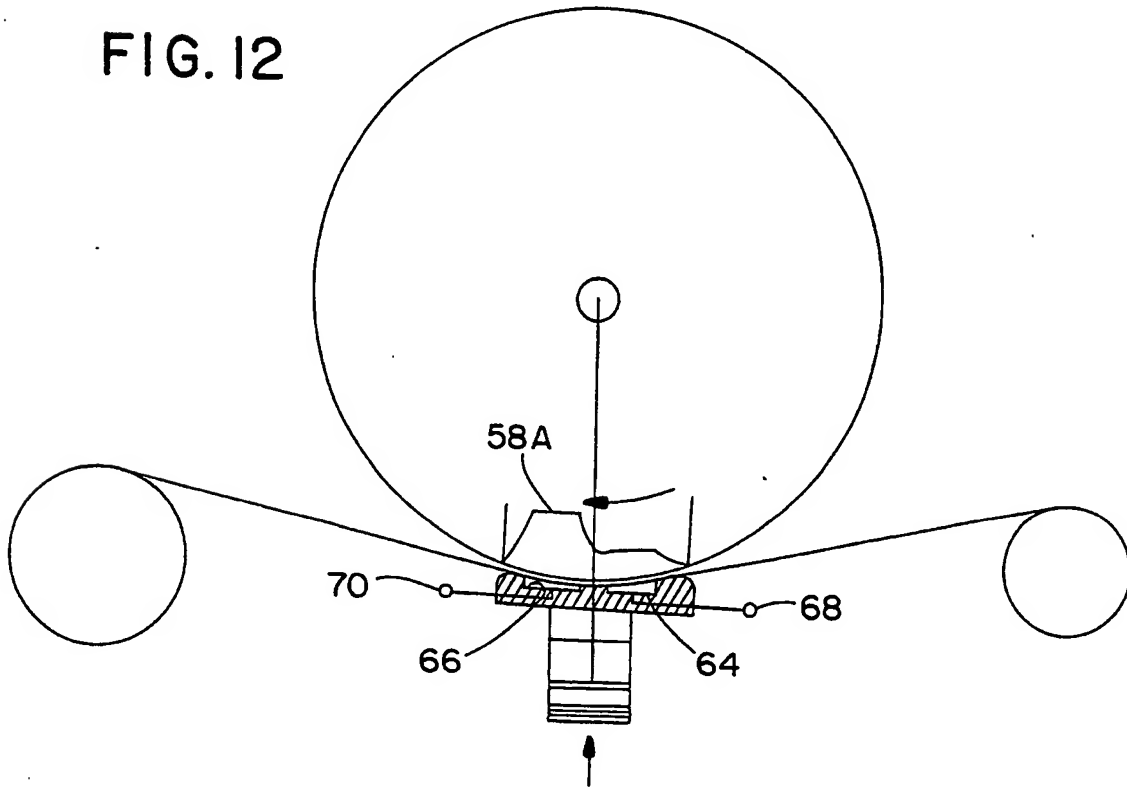


FIG. 12

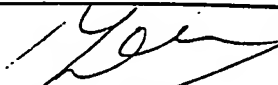


SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 90/02147

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 D21F3/02		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	D21F	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	GB,A,2199398 (SULZER-ESCHER WYSS) 06 July 1988 see the whole document ---	1, 3, 7, 9
Y	US,A,4713147 (SAARINEN) 15 December 1987 see the whole document ---	1, 3, 4, 9
A		5, 6
Y	EP,A,258169 (BELOIT) 02 March 1988 see the whole document ---	1, 3, 4, 9
A	(cited in the application) ---	2
Y	EP,A,155465 (SULZER-ESCHER WYSS) 25 September 1985 see the whole document ---	1, 3, 9
Y	WO,A,8902005 (BELOIT) 09 March 1989 see the whole document ---	1, 3, 9
	--- -/--	
<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"R" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
04 OCTOBER 1990	22 OCT 1990	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	DE RIJCK F. 	

III, DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,151447 (SULZER-ESCHER WYSS) 14 August 1985 see the whole document ---	1, 7
A	FR,A,2219836 (ESCHER WYSS) 27 September 1974 see the whole document ---	1
A	EP,A,66528 (BELOIT) 08 December 1982 ---	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

PCT/90/02147
SA 37534

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

04/10/90

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2199398	06-07-88	DE-A- 3705241	07-07-88
		SE-A- 8705062	25-06-88
US-A-4713147	15-12-87	None	
EP-A-258169	02-03-88	US-A- 4738752	19-04-88
		AU-B- 597404	31-05-90
		AU-A- 7677987	18-02-88
		JP-A- 63050594	03-03-88
		US-A- 4874469	17-10-89
		ZA-A- 8705911	12-02-88
EP-A-155465	25-09-85	CA-A- 1234307	22-03-88
		DE-A, C 3408119	14-08-85
		DE-A- 3561077	07-01-88
		US-A- 4556454	03-12-85
WO-A-8902005	09-03-89	AU-A- 2314288	31-03-89
		EP-A- 0377641	18-07-90
EP-A-151447	14-08-85	CA-A- 1234306	22-03-88
		DE-A, C 3408118	14-08-85
		DE-A- 3565292	03-11-88
		JP-A- 60181394	17-09-85
		US-A- 4661206	28-04-87
FR-A-2219836	27-09-74	CH-A- 563867	15-07-75
		AT-B- 325409	27-10-75
		DE-A- 2313920	05-09-74
		GB-A- 1407389	24-09-75
		SE-B- 407364	26-03-79
		US-A- 3974026	10-08-76
EP-A-66528	08-12-82	US-A- 4428797	31-01-84
		CA-A- 1166499	01-05-84
		JP-A, B, C 57199889	07-12-82
		US-A- 4427492	24-01-84
		US-A- 4425190	10-01-84

EPO FORM P009

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82